



Farnell

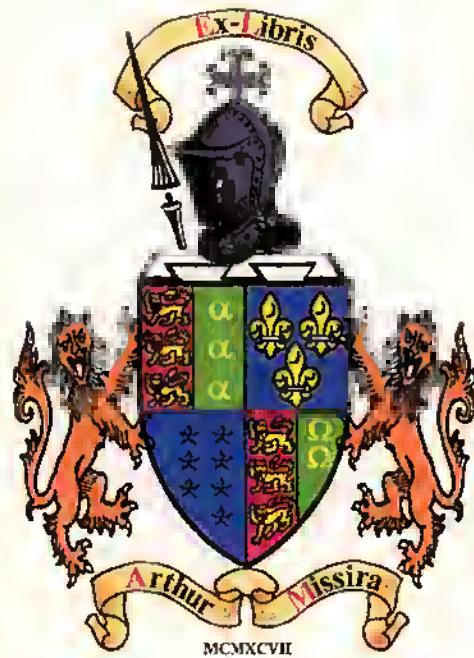
LFM3 BROADBAND TEST OSCILLATOR

INSTRUCTION BOOK



INSTRUCTION BOOK FOR

LFM3 BROADBAND TEST OSCILLATOR



The instrument has been carefully packed to prevent damage in transit. When removing the unit from the box, be sure to remove all parts and accessories from the packing material.

The complete equipment comprises:-

- a) 1 off LFM3 broadband test oscillator
- b) 1 off b.n.c. to open end coaxial lead
- c) 1 off Instruction book

Optional accessories

- a) Extension card for in-house recalibration

Note:- In the event of damage in transit or shortage in delivery, separate notices in writing should be given to both the carriers and Farnell Instruments Ltd., within three days of receipt of the goods, followed by a complete claim within five days. All goods which are the subject of any claim for damage in transit or shortage in delivery should be preserved intact as delivered, for a period of seven days after making the claim, pending inspection or instructions from Farnell Instruments Ltd., or an agent of this Company.

INTRODUCTION

The LFM3 is a high performance oscillator capable of producing low distortion sine waves at frequencies up to 10MHz and square waves up to 1MHz.

The frequency range of 10Hz to 10MHz is covered by 6 push button actuated decade ranges each continuously variable by the frequency dial.

Amplitude is continuously variable from about 1mV to 20V pk-pk into open circuit, via seven 10dB push button steps and a fine amplitude control to give variation between these steps. Two output sockets offer an Impedance choice of 50Ω or 600Ω.

Square wave operation is selected by the depression of a further push button. A TTL compatible output is available from the LFM3 when operating in the square wave mode.

A sine wave is continuously available from the sync. socket. The meter monitors the output of the LFM3 and for convenience is calibrated in V rms for sine and V pk-pk for square wave operation into a matched load (i.e. 50Ω or 600Ω).

The instrument is normally supplied set for operation from a 50/60Hz mains supply of 190 to 260 volts, but can be supplied or adjusted for operation from 95 to 130 volts.

SPECIFICATION

(All parameters after 1 hour warm up time)

FREQUENCY RANGE	10Hz to 10MHz sine wave in 6 switched ranges 10Hz to 1MHz square wave
SCALE ACCURACY	2% of scale reading 100Hz to 100kHz 3% of scale reading 10Hz to 100Hz 3% of scale reading 100kHz to 1MHz 10% of scale reading 1MHz to 10MHz
FREQUENCY STABILITY for $\pm 10\%$ change from 220V	0.2%
AMPLITUDE STABILITY for $\pm 10\%$ change from 220V	0.2% for 10Hz to 1MHz 0.5% for 1MHz to 10MHz
TEMPERATURE COEFFICIENT	Frequency 0.03% per $^{\circ}\text{C}$ typical Amplitude 0.3% per $^{\circ}\text{C}$ typical
FREQUENCY RESPONSE (flatness)	100Hz to 1MHz $\pm 0.2\text{dB}$, 1MHz -10MHz $\pm 3\text{dB}$
DISTORTION at full rated output into 50Ω load	0.1%, 100Hz to 20kHz 0.5%, 10Hz to 100Hz 0.5%, 20kHz to 1MHz 5%, 1MHz to 10MHz approx. half these figures at half output no load
OUTPUT VOLTAGE	20V pk-pk into open circuit
OUTPUT IMPEDANCE	50Ω and 600Ω
PROTECTION	Short term short circuit
SQUARE WAVE RISE/FALL TIME	Less than 35ns
TTL OUTPUT	Square wave, nominal 5V amplitude, available only when operating in square wave mode TTL fan out of 10
SYNC. OUTPUT	6V pk-pk approx. sine wave, source impedance 10kΩ
METER CALIBRATION	Sine wave V r.m.s.) into matched Square wave V pk-pk) load dB scale provided ref. 0dB = 1mW into 600Ω
ACCURACY	3% of f.s.d. 100Hz to 1MHz, 10% of f.s.d. 1MHz to 10MHz
ATTENUATOR	7 steps of 10dB per step
ATTENUATOR ACCURACY	1% 10Hz - 300kHz 2% 300kHz - 1MHz 15% 1MHz - 10MHz
OPERATING AMBIENT TEMPERATURE RANGE	0° to 40°

SPECIFICATION

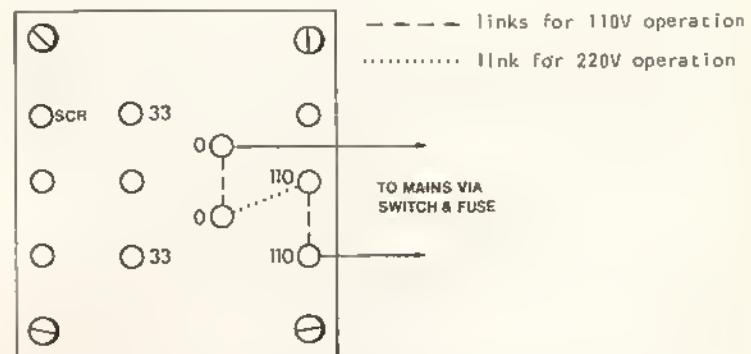
MAINS SUPPLY	A.C. mains 190 to 260V, 50/60Hz or 95 to 130V, 50/60Hz by internal link change
POWER CONSUMPTION	Maximum 50 watts
DIMENSIONS (overall)	Height 130 mm Width 320 mm Depth 265 mm
WEIGHT	4.3 kg

OPERATING INSTRUCTIONS

Installation

The LFM3 is normally supplied set for use with a.c. mains of 190-260V, 50/60Hz. The alternative 95-130V setting is obtained by connecting the two primaries of the mains transformer in parallel as shown in fig. 1.

Fig. 1



The three core mains lead must be connected as follows:-

Brown	-	Mains line
Blue	-	Neutral
Green/yellow	-	Earth

First time operation

Connect an oscilloscope to the 50Ω output socket.

Select sine wave operation by ensuring that the SINE/SQUARE push button is out. Reading along the top of the bank of attenuator switches in line with the legend 'SINE' over the sine-square function push button, depress the '3V' button on the attenuator bank. Set the 'FINE AMPLITUDE' control to maximum (i.e. fully clockwise). Turn the frequency dial to 1 and select the X1K range. Connect the instrument to the mains supply and depress the push button marked 'POWER'. The neon indicator will light, the meter will indicate approx. full scale and the oscilloscope should display a 1kHz sine wave of about 20V pk-pk amplitude.

Sine wave operation

Ensure that the SINE/SQUARE push button is out. Select the required frequency by using the dial and frequency multiplier push buttons. The output amplitude can be ascertained by reading off the meter scale in conjunction with the legends above the attenuator push buttons. It should be noted that the meter displays the r.m.s. output voltage developed into a matched load of either 50Ω or 600Ω. In the case of no load on the output terminals the output voltage will be twice that shown by the meter.

The 'FINE AMPLITUDE' control allows the output to be varied over each 10dB step.

CIRCUIT DESCRIPTION

Square wave operation

Depress the 'SINE/SQUARE' button and select the required frequency by adjusting the frequency dial in conjunction with the frequency multiplier buttons. The maximum specified operating frequency is restricted to 1MHz although an output is available in the range 1MHz-10MHz.

The output meter shows the pk-pk amplitude into a matched load, and is read in conjunction with the legend below the attenuator button depressed.

To prevent excessive ringing and overshoot of the waveform at the load, it is necessary to feed the load with a coaxial cable of characteristic impedance the same as that of the load, and that the load impedance should be 50Ω or 600Ω (purely resistive), appropriate to the output socket used.

Sync. output

This sine wave only output is always available and being derived prior to the output amplifier may be used to trigger ancillary equipment, such as an oscilloscope. Alternatively it may be used as a fixed amplitude low distortion sine wave output with a source impedance of approximately 10kΩ.

TTL output

This output is only available when the square wave function has been selected. It is capable of driving ten standard TTL unit loads and sinks approximately 16mA in the low state.

The LFM3 may be divided into five sections comprising:- Power Supply, Oscillator, Output Amplifier and Attenuator, Meter drive and Square Wave.

The power supply and attenuator are on the mother board into which the amplifier, meter and square wave boards plug. The oscillator board is housed within the screened enclosure and is connected via a plug-in lead to the mother board.

Power supply

Each of the two supply rails (+25V & -25V) is derived from a full-wave rectifier via an emitter follower driven by a differential pair amplifier. A 5.1 volt zener provides the reference voltage.

Both lines are independently adjustable and are protected by fuses accessible on the rear panel.

Oscillator

The oscillator is based on the Wien bridge circuit and uses a thermistor in the negative feedback loop to stabilise the amplitude. Bounce whilst tuning is minimised by using a variable ganged capacitor and by ensuring that both 'arms' of the bridge are balanced. Range change is accomplished by switching in different resistor values. A junction F.E.T. VT1 is used at the front end of the amplifier to minimise loading on the high value frequency determining resistors. VT2 and VT3 form a differential pair and an output is taken from the collector VT3 to drive the cascode circuit of VT6 and VT5.

A push-pull output circuit is used to give a low output impedance with a good bandwidth.

Output amplifier

VT201 and VT202 are the voltage amplifiers and drive the emitter follower VT203. In turn VT203 drives the parallel class A output stage VT205 and VT207. An active current source for the output stage is provided by VT204 and VT206. Overall negative feedback is applied to VT201 emitter via R210 and R205. The d.c. output level is set by P201 and P202.

An 'L' section passive attenuator is used, the degree of attenuation being selected by the push button attenuator switch.

Meter drive

The signal appearing at the output of the amplifier is routed via the sine-square switch to the base of VT309. VT309 and VT308 form a cascode drive circuit. Good linearity is obtained from this circuit due to the high drive impedance from the collector VT308 and the 'bootstrapped' resistor R326 thus masking any non-linearity of the diode impedance.

Square wave

For square wave operation the output of the oscillator is fed to emitter follower VT301, which in turn drives the Schmitt trigger VT302 and VT303. To achieve a low output impedance the output is derived from an emitter follower.

The TTL output is provided by VT306 acting as a saturated switch.

MAINTENANCE

Guarantee

The equipment supplied by Farnell Instruments Ltd. is guaranteed against defective material and faulty manufacture for a period of twelve months from the date of despatch. In the case of material or components employed in the equipment but not manufactured by us, we allow the customer the period of any guarantee extended to us.

The equipment has been carefully inspected and submitted to comprehensive tests at the factory prior to despatch. If, within the guarantee period, any defect is discovered in the equipment in respect of material or workmanship and reasonably within our control, we undertake to make good the defect at our own expense subject to our standard conditions of sale. In exceptional circumstances and at the discretion of the Service Manager, a charge for labour and carriage costs incurred may be made.

Our responsibility is in all cases limited to the cost of making good the defect in the equipment itself. The guarantee does not extend to third parties, nor does it apply to defects caused by abnormal conditions of working, accident, misuse, neglect or wear and tear.

Maintenance

In the event of difficulty, or apparent circuit malfunction, it is advisable to telephone or telex the Service Department or your local Sales Engineer or Agent (if overseas) for advice before attempting repairs.

For repairs and re-calibration it is recommended that the complete instrument be returned to:-

The Service Department,
Farnell Instruments Ltd.,
Sandbeck Way,
Wetherby, Yorkshire,
LS22 4DII
Tel: 0937 3541 Telex: 557294

or

Service Depot,
Farnell Instruments Ltd.,
2 Urley Court,
Greenford Road,
Harrow, HA1 3QD, Middx.
Tel: 01-864 7433 & 7434

Please ensure adequate care is taken with packing and arrange insurance cover against transit damage or loss.

For those who operate their own comprehensive service departments and wish to repair and maintain the equipment themselves, a section on re-calibration follows.

RE-CALIBRATION

For those possessing a comprehensive service facility the following is given as a guide to the recalibration of an LFM3. An extension card, available from Farnell Instruments Ltd, will be required.

1. Power supply
 - a) To adjust +25V line rotate P101
 - b) To adjust -25V line rotate P102.
2. D.C. output level of amplifier
 - a) Allow 30 minute warm up period. Monitor 50Ω output socket with oscilloscope. Select sine wave operation at 1kHz and maximum output of 20V pk-pk.
 - b) Adjust P201 to centre the display about zero.
 - c) Turn fine amplitude fully anti-clockwise and adjust P202 to give 0V d.c. out.
 - d) Repeat 2b and c as necessary until a mean d.c. level of 0V is obtained in both cases.

Square wave adjustments

Monitor 50Ω output socket with d.c. coupled oscilloscope. Set LFM3 controls to 1kHz, square wave, 'FINE AMPLITUDE' fully clockwise, '10V' pk-pk push button depressed.

- a) Adjust P301 to give equal mark space ratio
- b) Adjust P302 to give output amplitude of 21V pk-pk
- c) Adjust P303 to centre waveform about 0V
- d) Repeat b and c until both conditions are met.

Meter adjustments

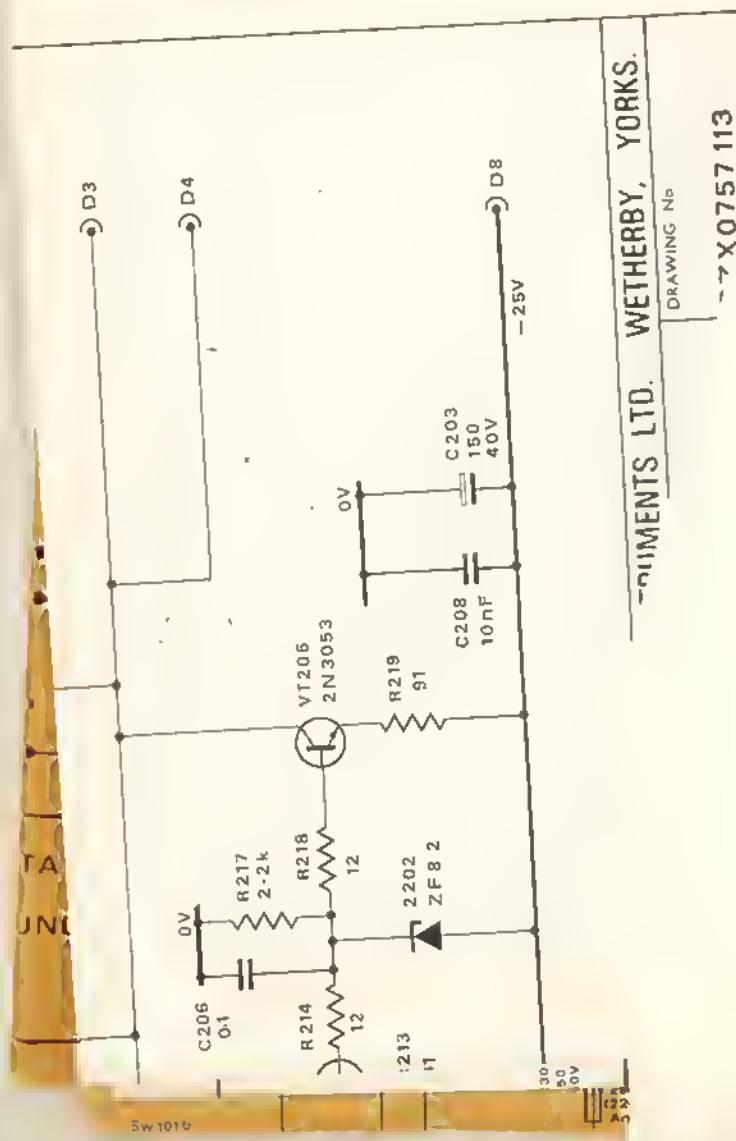
Monitor 50Ω output with suitable meter of known accuracy. LFM3 controls set to 1kHz, square, '10V' pk-pk button depressed.

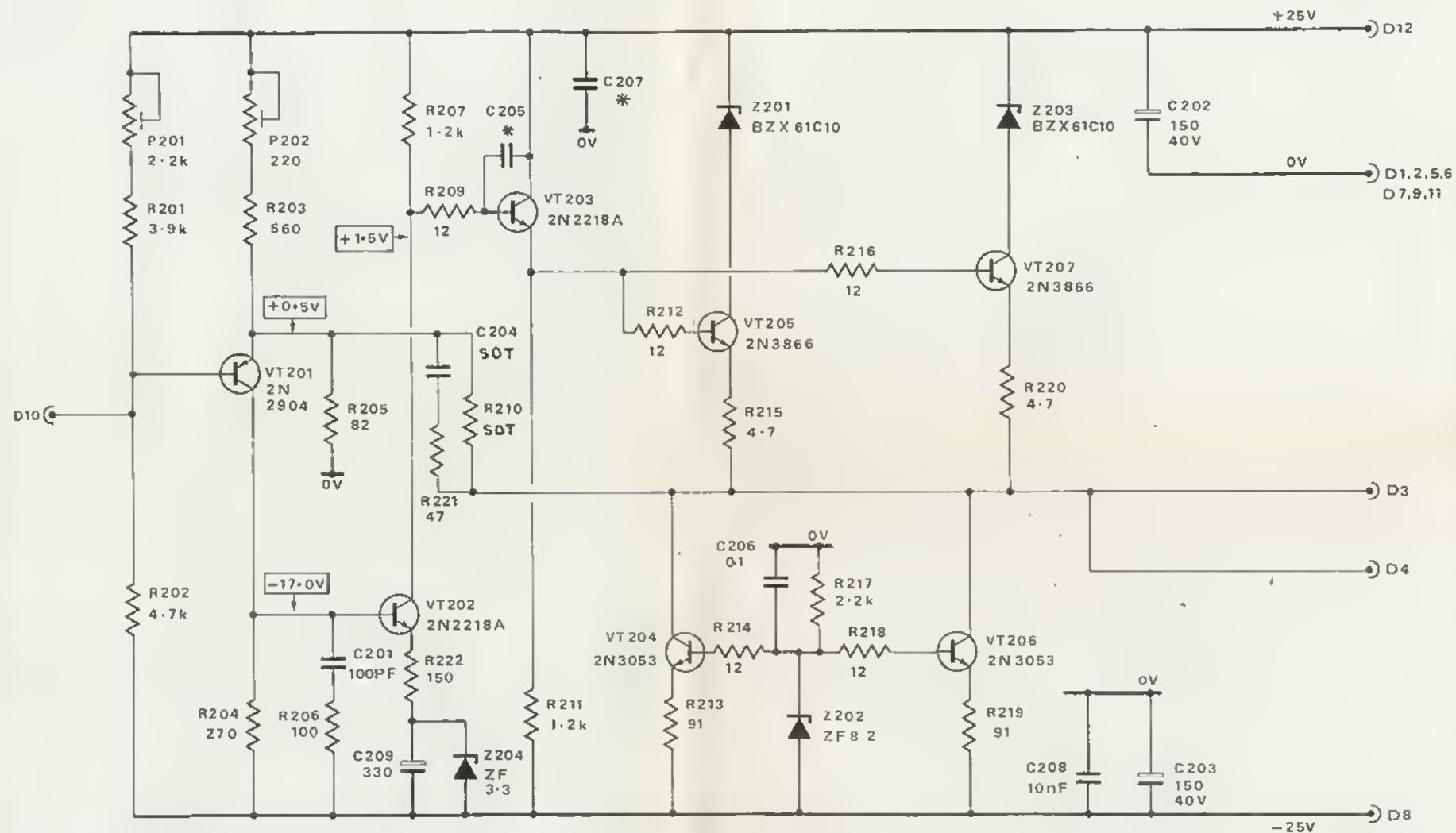
- e) Adjust 'FINE AMPLITUDE' so that reference meter indicates 20V pk-pk (scaling factors might have to be used depending on whether reference meter is average reading calibrated r.m.s. etc.)
- f) Adjust P305 to set LFM3 meter deflection to 10V pk-pk.
- g) Switch to sine wave. Leaving 'FINE AMPLITUDE' control in previous position adjust P1 on oscillator board to give output of 7.07 volts on reference meter. (P1 is accessible after removing the satin anodised handle recess on the enclosure side).
- h) Adjust P304 (meter and square board) so that LFM3 meter indicates 3.5V r.m.s.
- j) Set LFM3 to 8MHz sine wave leaving 'FINE AMPLITUDE' control in same position. Adjust C312 so that LFM3 meter indicates $\frac{1}{2}$ of reference meter reading.

Oscillator frequency calibration

These adjustments should only be necessary if any of the components within the oscillator enclosure have been changed. A frequency meter, an oscilloscope and insulated trimming tool will be required. Access to the trimmers can be obtained after removing handle and trim.

- 1) Select X1k range, sine wave, and full output. Connect oscilloscope and frequency meter to 50Ω output socket. Confirm that 1kHz is obtained with dial in '1' position.
- 2) Turn dial to 10 and adjust C11 and C1 (if fitted) for minimum capacity i.e. maximum frequency.
- 3) Adjust C11 for minimum bounce. This may be determined by rocking the frequency control knob back and forth while viewing the oscilloscope display.
- 4a) If with the dial set at 10 the frequency is greater than 10kHz then adjust C11 and C1 to give equal frequency decrements.
- 4b) If the frequency is less than 10kHz, adjust C11 to give 10kHz.
- 5) Turn the dial to 1 and confirm that the frequency is 1.00kHz. If not, slacken grub screw on capacitor spindle coupling. With dial still in 1 position adjust frequency control capacitor to give a frequency of 1kHz. If this adjustment is made it will be necessary to repeat 3 and 4 again and to check 5.
- 6) Turn dial to 10 position again and depress X10k button. Confirm that the frequency is 100kHz.
- 7) Depress X100k button and adjust C10 and C2 where fitted for maximum frequency. Follow procedure outlined in 3 and 4 to obtain 1MHz with minimum bounce.
- 8) Depress X1M button and adjust C9 and C3 where fitted for maximum frequency. Follow procedure in 3 and 4 to obtain a frequency of 10MHz with minimum bounce.
- 9) Set dial to 1 and depress X10 button. Frequency should be 10Hz. If not it will be necessary to select resistors of equal value to fit in positions R1 and R20.
- 10) Depress X100 button and repeat selection process for R2 and R21 to give a frequency of 100Hz.
- 11) Check that on X10 range 10Hz is obtained and that on X100 range 100Hz is obtained.

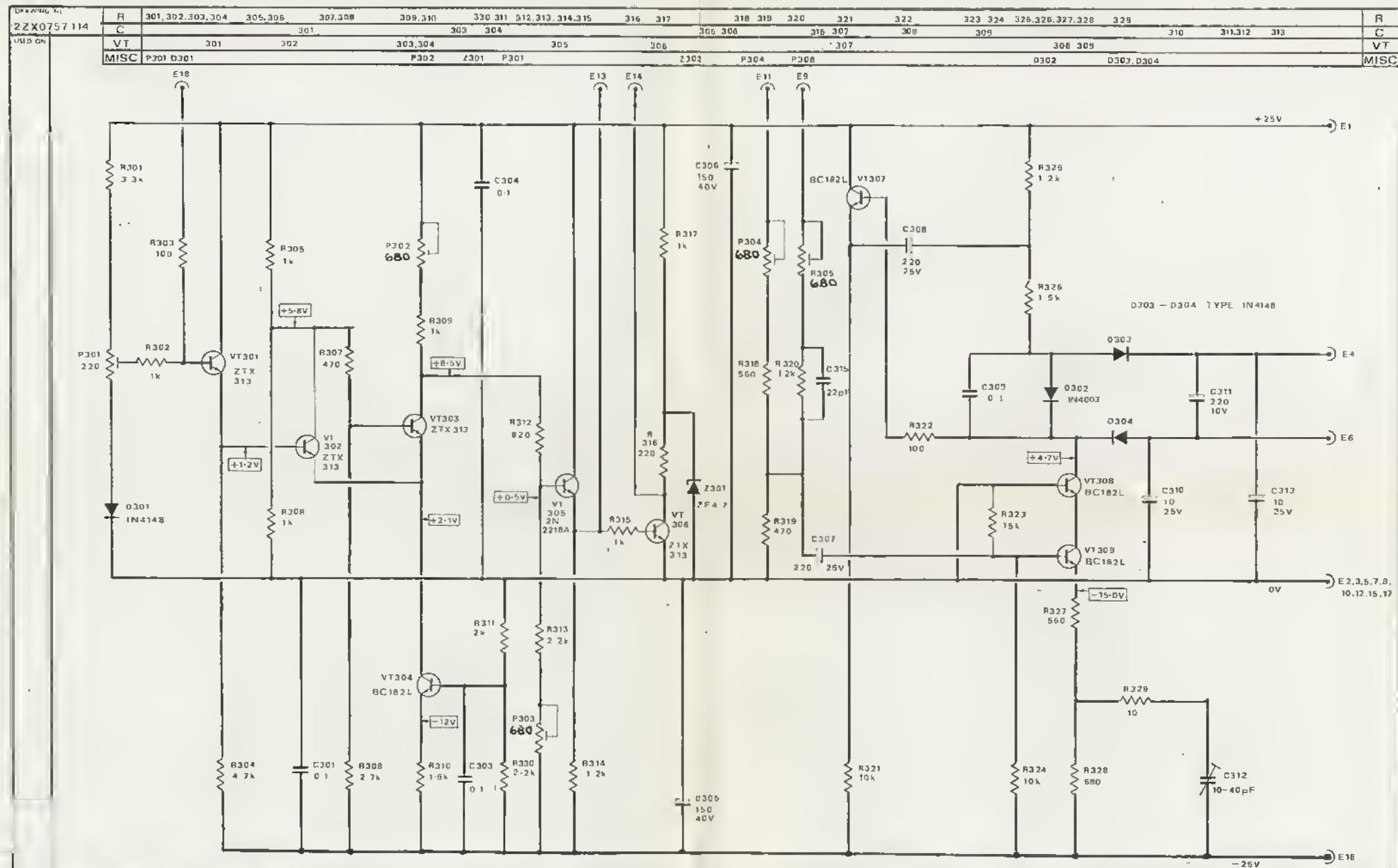




TRACED						
CHECKED		C 21.12.76	04076			
	BC	B 18.12.75	Q 3557			
DRAWN	M.H.	ISS	DATE	MOD No		
		A	20.5.75			

NOTE
CAPACITOR VALUES GIVEN IN μ F
RESISTOR VALUES IN Ω
⑦ REFERS TO CCT BD.
PIN CONNECTION NO.
* COMPONENT NOT
ALWAY FITTED.

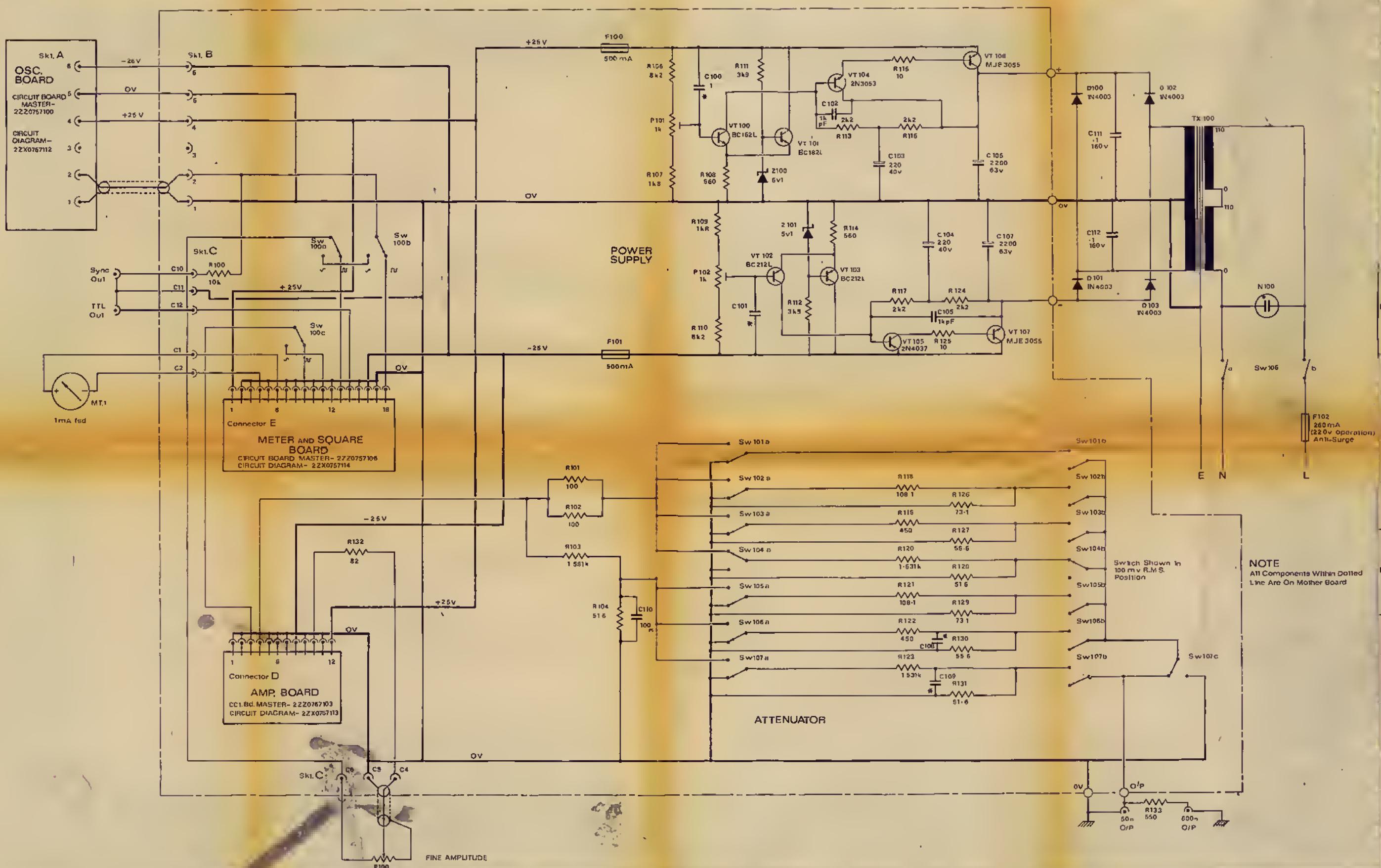
FARNELL INSTRUMENTS LTD. WETHERBY, YORKS.
CIRCUIT DIAGRAM DRAWING No
AMPLIFIER CIR. BOARD. LFM3 3ZX0757 113



NOTE ALL RESISTOR VALUES IN OHMS UNLESS STATED OTHERWISE
ALL CAPACITOR - II MICROFARADS UNLESS STATED OTHERWISE

CHECKED	E 21676 Q3860
REMOVED	B 19-12-75 Q 3497
DRAWN	ISSUED DATE MOG No.
M.H.	A 9:8:75

FARNELL INSTRUMENTS LTD. WETHERBY, YORKS.
TITLE CIRCUIT DIAGRAM DRAWING NO. 2ZX0757 114
METER & SQUARE LFM3 SHEET 1 OR 1 SHEETS



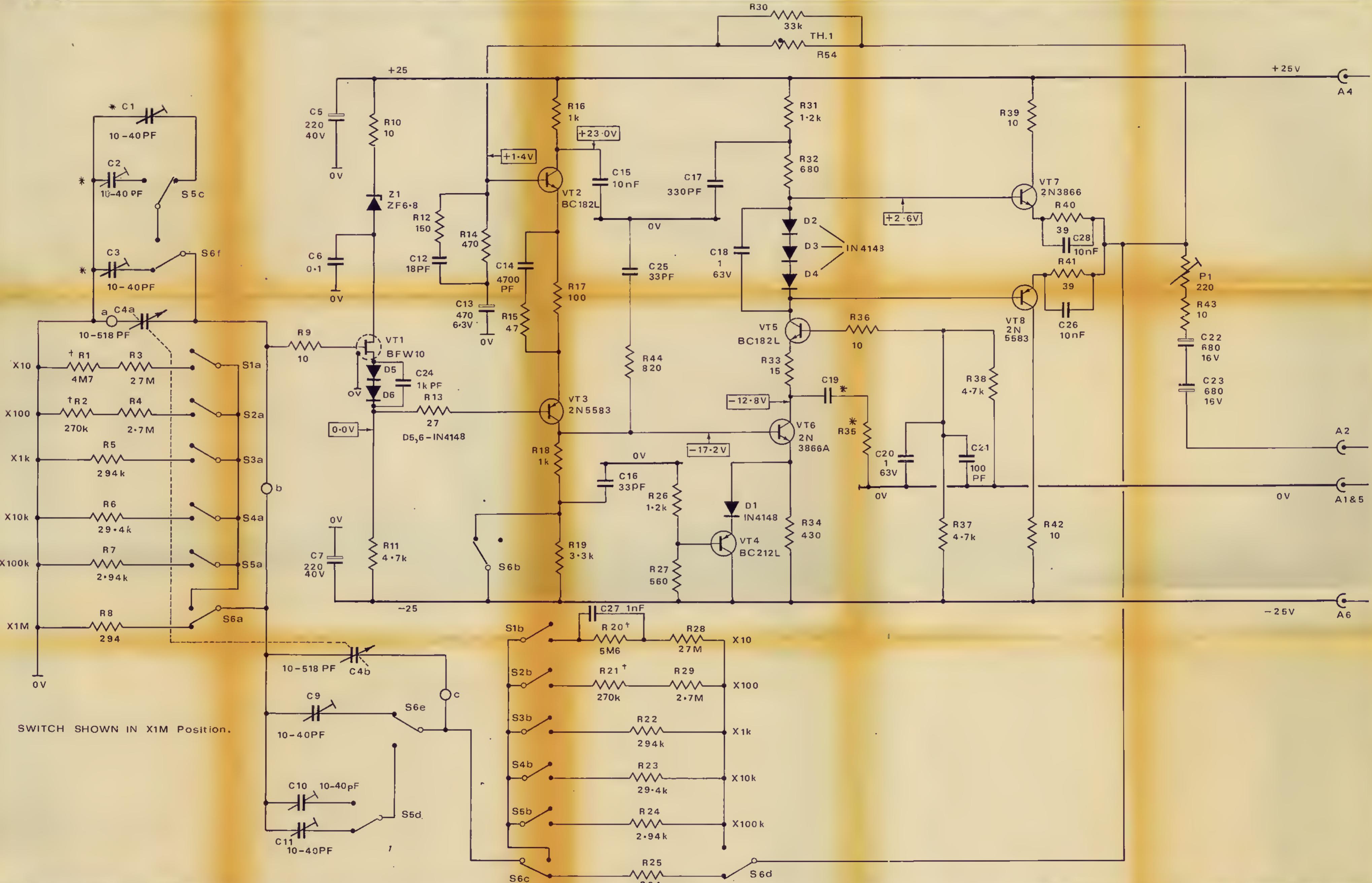
TRACID	D	7-3-76	Q3944
CHICKID	C	15-4-75	Q3818
BRANDS	B	18-12-75	Q3857
DRAWN	ISSUE	DATE	MOD. No.
SA	A	23-7-75	-

ALL RESISTORS IN OHMS UNLESS OTHERWISE STATED
CAPACITORS IN MICRO FARRADS UNLESS OTHERWISE STATED
O REFERS TO CIRCUIT BOARD PIN
D REFERS TO CIRCUIT BOARD SOCKET
S SCREENED CABLE

* COMPONENTS NOT ALWAYS FIT

FARNELL INSTRUMENTS LTD. WETHERBY, YORKS.

DRAWING No.	R	1,2,3,4,5,6,7,8	9	10,11	12,13	14	15	44,16,17,18,19,20,21,22,23,24,25,26,27,28,29,	30,31,32,33,34,	36	37	38	39,42,43,41	43
2 ZX0757 112	C	1,2,3,4a	11,10,9,4b,5,6,7	24 12	13	14	15	16	25	27	17	18	20	21
USED ON	VT			1	2 3		4	5 6		7 8			22 23	
MISC.		S5c S6f S1a - S6a	D5,6 21 S5d S6e S6f S1b - S6b		S6d D1	D2,3,4 TH.1					P1			MISC.



TRACED	E 13/3/79 Q5326		
	D 22/12/79 Q4112		
CHECKED	C 21/9/79 Q4016		
B.C. 18.12.75	Q 3597		
DRAWN	ISS. DATE	MOD. No.	
M.H.	A 24/7/75	-	

NOTE: ALL RESISTOR VALUES IN OHMS UNLESS STATED OTHERWISE.

ALL CAPACITOR VALUES IN MICROFARADS UNLESS STATED OTHERWISE.

* NOT ALWAYS FITTED

† MAY ALTER ON TEST

FARNELL INSTRUMENTS LTD. WETHERBY, YORKS.

TITLE: CIRCUIT DIAGRAM
OSC. & FREQ. LFM 3
DRAWING No. 2 ZX0757 112
SHEET 1 OF 1 SHEETS

FARNELL INSTRUMENTS LIMITED • SANDBECK WAY • WETHERBY • YORKSHIRE LS22 4DH • TELEPHONE 0937 63541